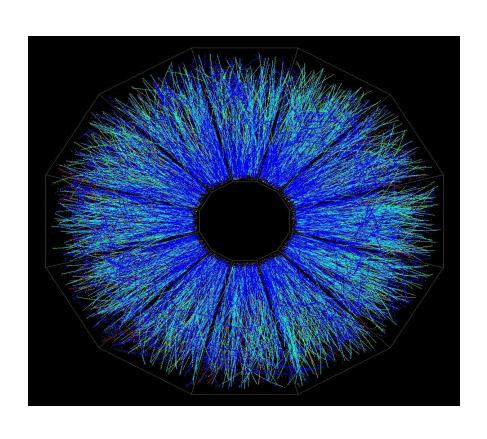
STAR Run 11 Status



Stephen Trentalange for the STAR Collaboration

STAR BUR11

Run	Beam Energy	Time	System	Goal	
11	√s _{NN} = 18, 27 GeV*	2 weeks	Au + Au	100, 150M minbias	
	√s _{NN} = 200 GeV	4 Week		200M minplas 200M central	
	√s = 500 GeV	5 weeks 6 weeks	p _↑ p _↑ p _→	trans. $P^{2*}L=4 \text{ pb}^{-1}$ long. $P^{2*}L=20 \text{ pb}^{-1}$	
		1 week	PIPI	PP-PP at high 6*	

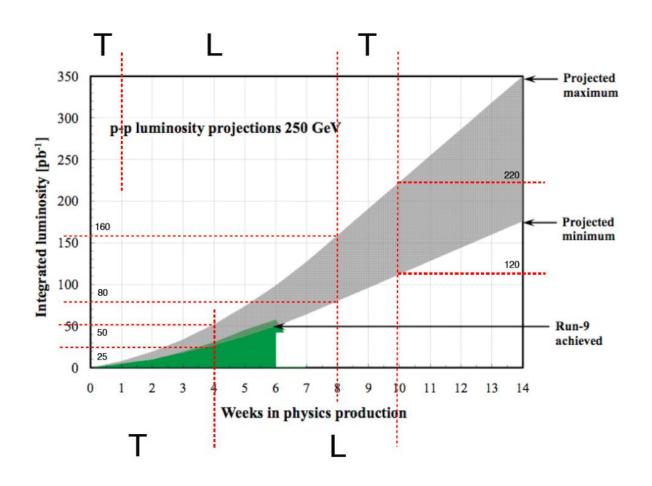
PAC Recommendations (in order of priority):

```
4. 1.5 weeks U+U heavy ion running at 192 GeV (Au rigidity)
```

500 GeV Polarized p+p: 10 Weeks

- Transverse p+p (Anticipated 4 weeks)
 - Forward Meson Spectrometer
 - Study A_N for Ws
- Longitudinal p+p (Anticipated 6 weeks)
 - $-A_1$ for Ws
 - $-A_{II}$ for Jets

Allocation of Beam Time



Run 11: Actually Delivered

• 500 GeV p+p:

Transverse polarization (8 weeks)

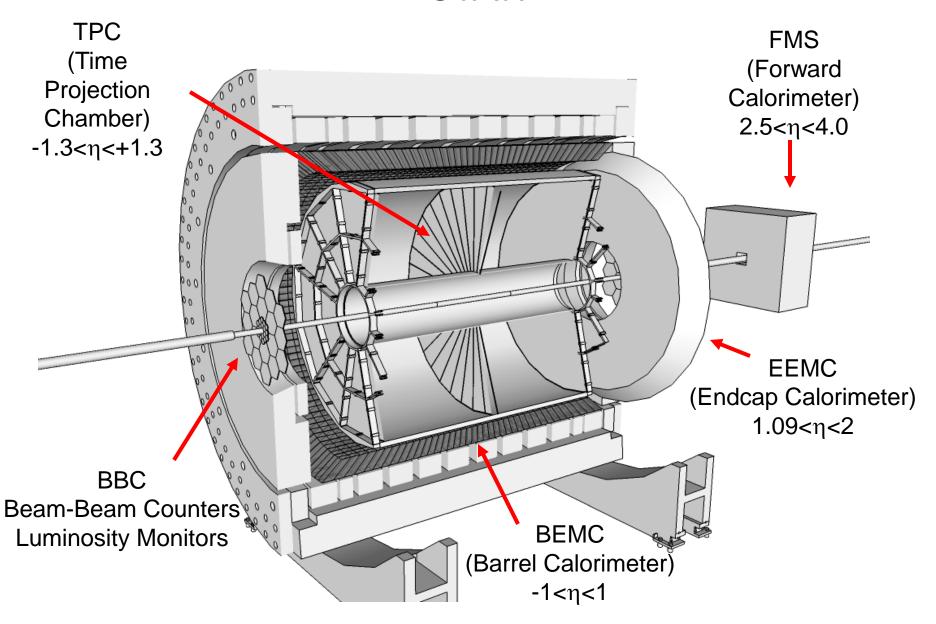
• 500 GeV p+p:

Longitudinal polarization (9 days)

- 19 GeV Au+Au (~10 days)
- 200 GeV Au+Au (7 weeks)
- 27 GeV Au+Au (1.5 weeks, est)

That the detectors and accelerator can handle such a wide variety of particle species, energies and polarization states is a tribute to how nimble the RHIC facility is!

STAR



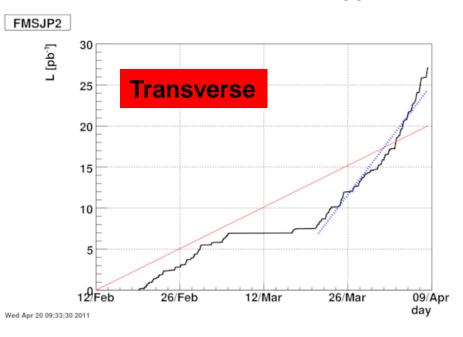
Run 11 Data Set

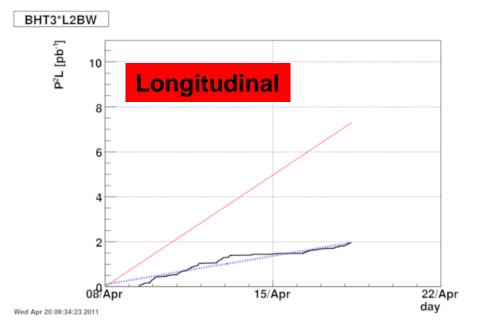
Transverse (8 weeks)

- <P> ~ 46% online from hydrogen jet
- 25+ /pb recorded luminosity
- ~80M+ Jet Patch 2 triggers FMS

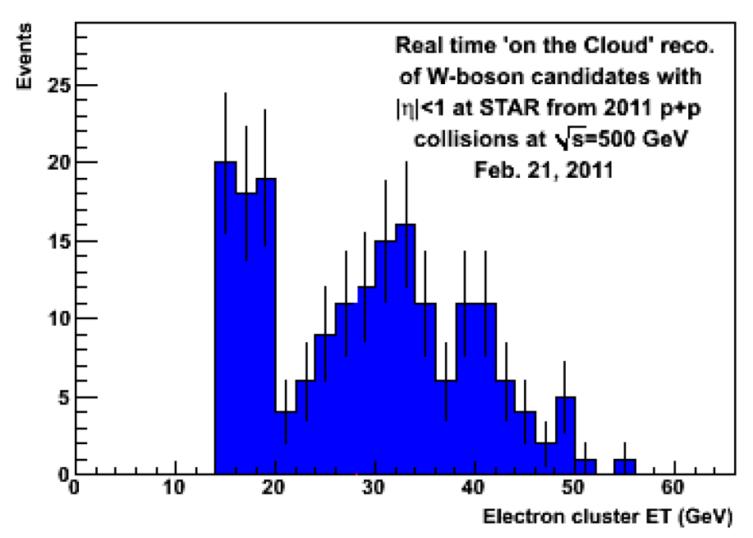
Longitudinal (9 days)

- <P> ~ 43% online
- 12 /pb recorded luminosity
- Similar lumi to Run 9 W sample



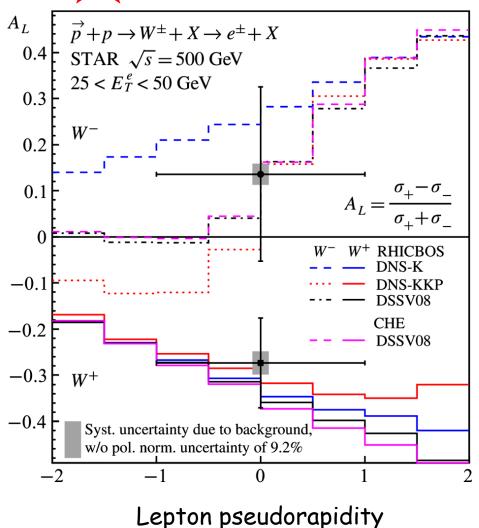


Run 11 "Online" Analysis: L~3.5 pb⁻¹



First **STAR** W A





$$A_L = \frac{\sigma_+ - \sigma_-}{\sigma_+ + \sigma_-}$$

STAR 2009 Result

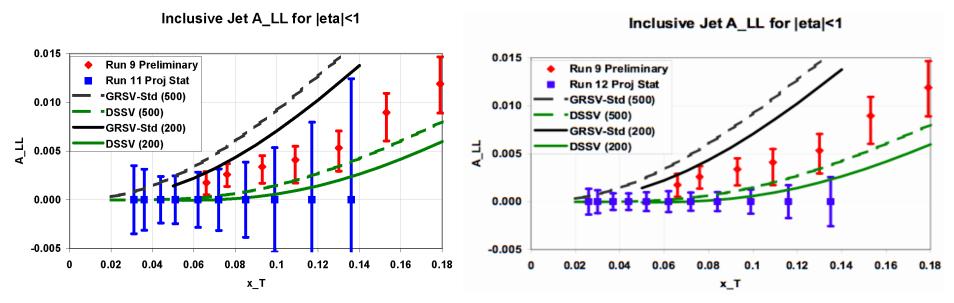
$$A_L(W^+) = -0.27 \pm 0.10(stat) \pm 0.02(syst)$$

 $A_L(W^-) = 0.14 \pm 0.19(stat) \pm 0.02(syst)$

Run 11: Sampled ~50% more FoM than during Run 9 → when the two runs are combined, uncertainties will drop by sqrt(1/2.5) ~ 0.63

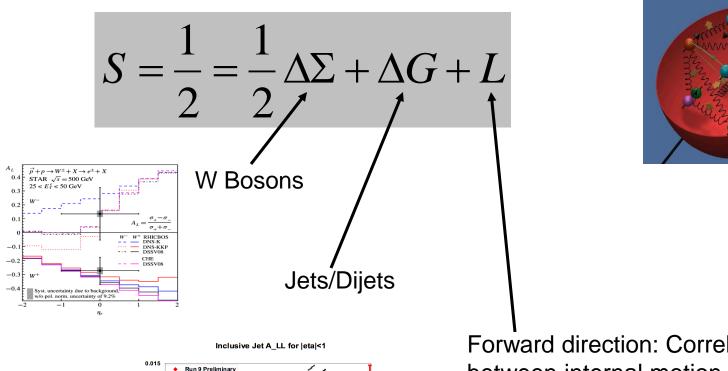
Expected Inclusive Jet A₁₁ Precision

Run 11 Run 12



- Run 11 is unlikely to teach us anything we didn't already learn from Run 9
- Run 12 will provide a very useful complement to Run 9
- During Run 13, we can further reduce the 200 GeV uncertainties compared to Run 9 by:
 - A factor of \sim 2 for jet p_T > \sim 12 GeV
 - A factor of \sim sqrt(2) for jet p_T < \sim 12 GeV

The Proton Spin Sum



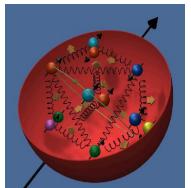
Run 12 Proj Stat
 - GRSV-Std (500)
 - DSSV (500)

0.04 0.06 0.08

0.1

0.12 0.14 0.16 0.18

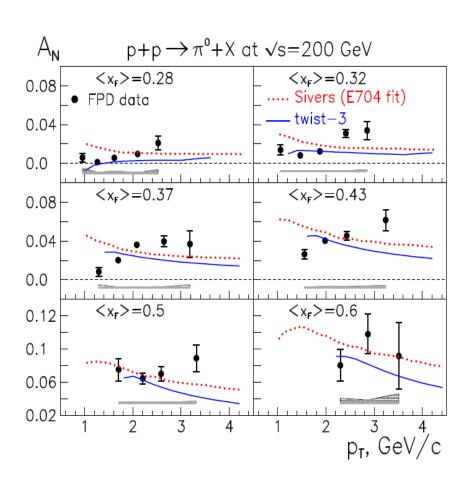
-0.005

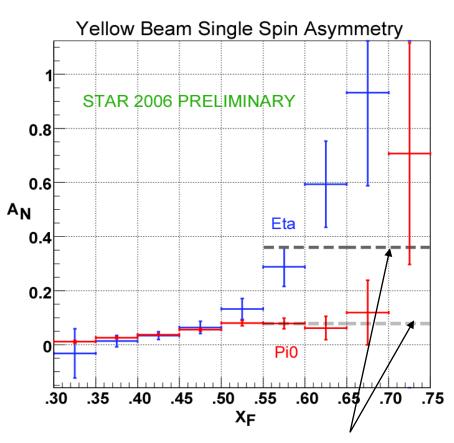


Forward direction: Correlation between internal motion of quarks and spin direction

Single Spin Asymmetries in the Forward Region

p_T Dependence of A_N Large η Asymmetries

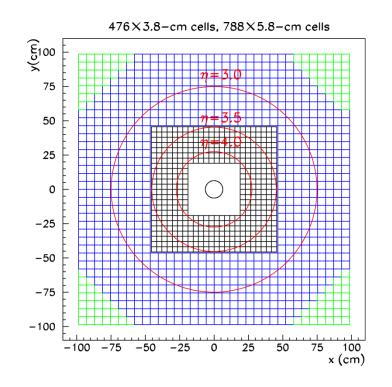


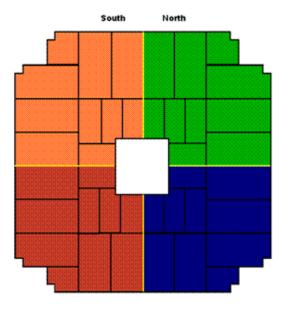


No sign of 1/p_T dependence

Dashed lines are average A_N for x>0.55

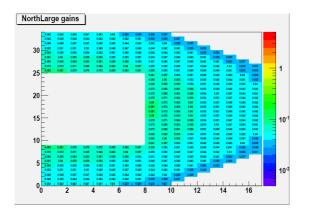
STAR Forward Meson Spectrometer





Trigger changed to give clusters (pions/etas) and jet patches

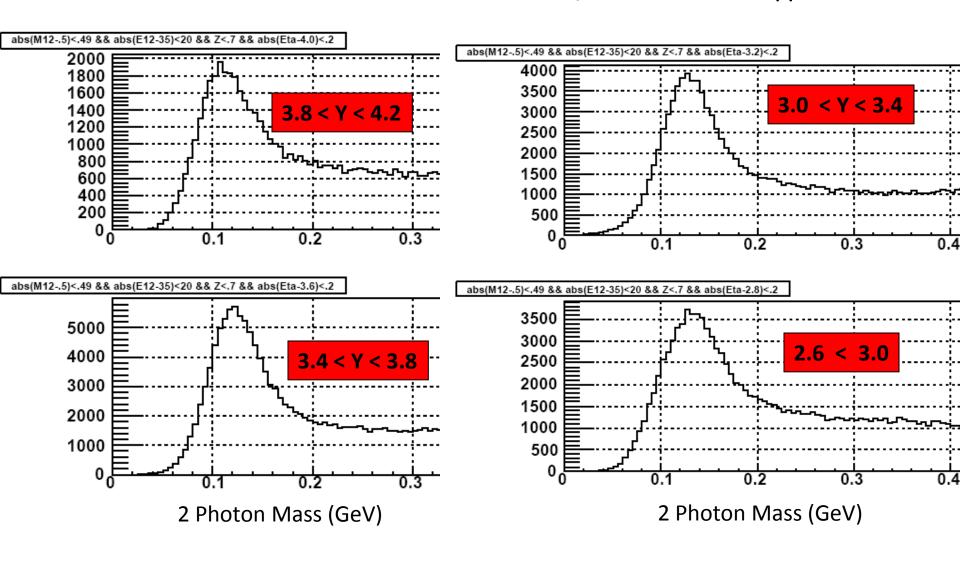
- 2π azimuth for **2.5**< η <**4.0**
- Discriminate single γ from $\pi^0 \rightarrow \gamma \gamma$ up to ~60 GeV



Gain profile changed from previous years: constant E_T rather than constant E; nearly uniform acceptance

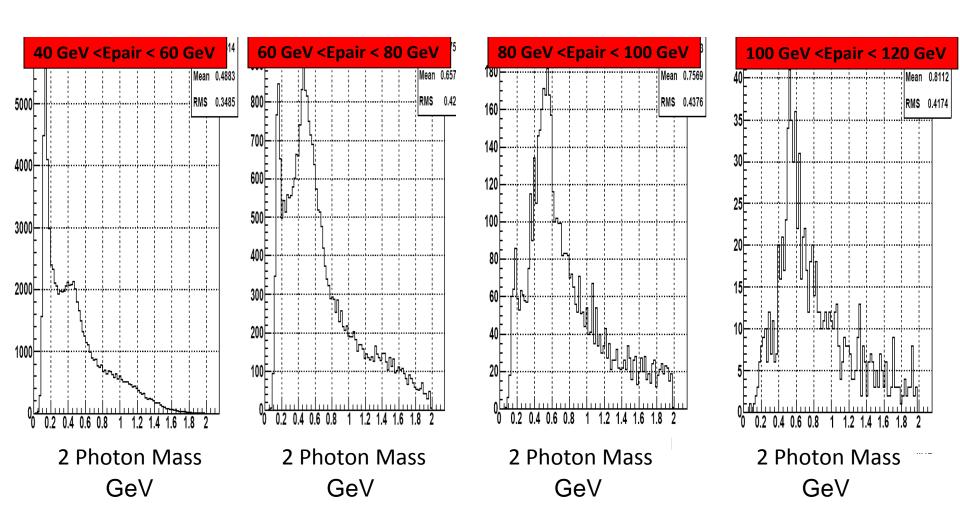
Pions in FMS (with Online Calibrations)

15 GeV< Epair<55 GeV , $Z\gamma\gamma$ < 0.7



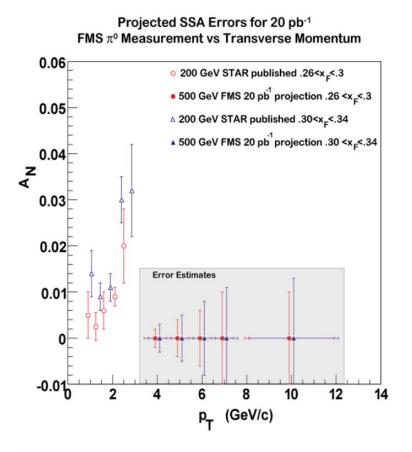
Pion and Eta Peaks at Higher Energies

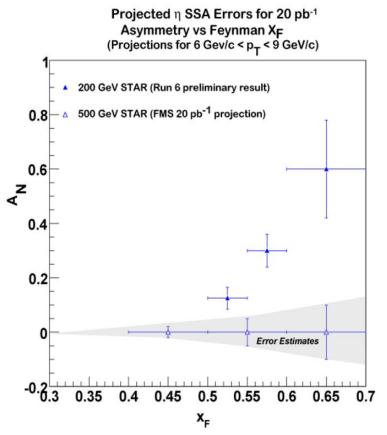
Two Photon Events, $3.46 < \eta < 3.85$, Z < 0.7



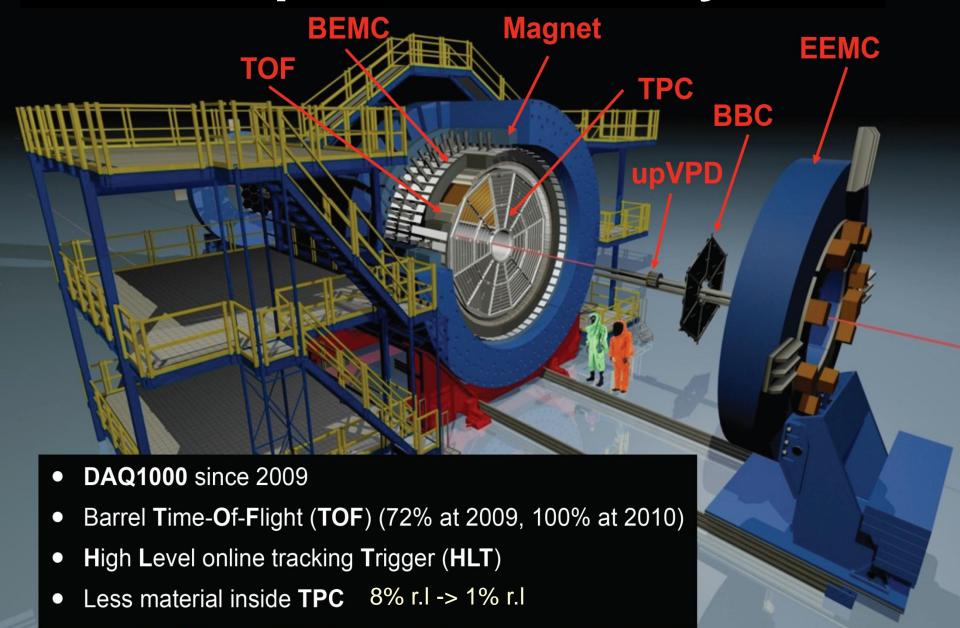
Run 11 Projections: 20 pb⁻¹

Goals of Run: Extend p_T reach for pions and x_F reach for eta mesons

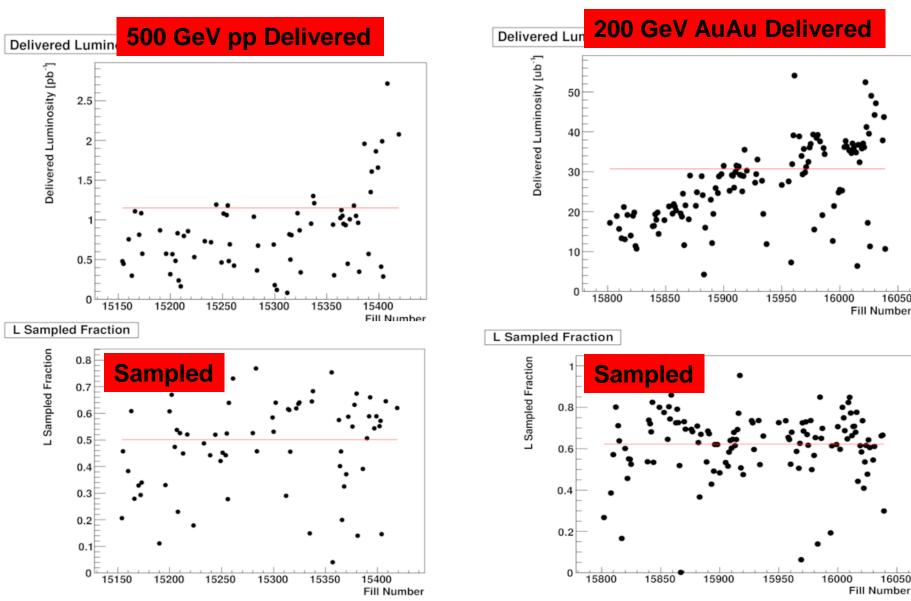


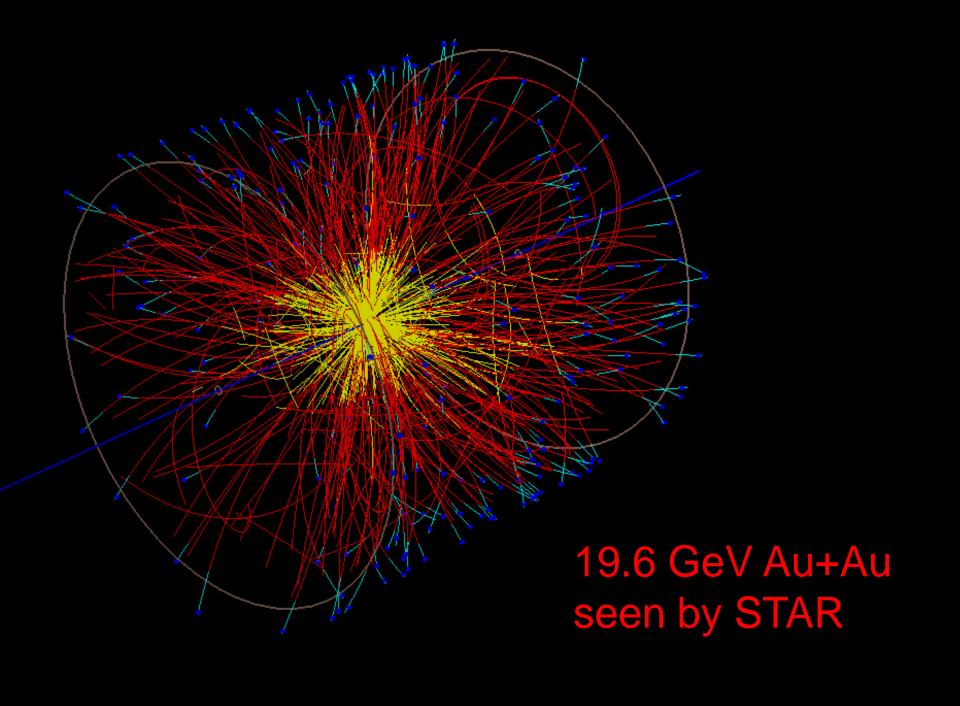


STAR Experiment: Heavy lons

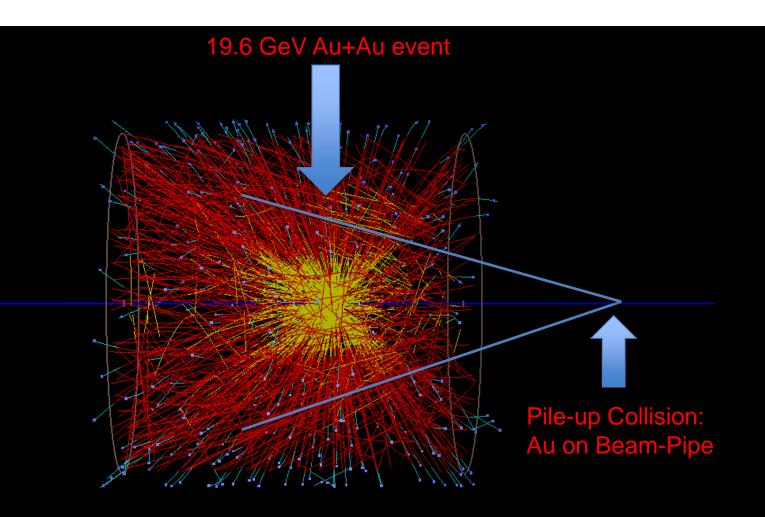


Delivered and Sampled Luminosity





Pile-up Tracks

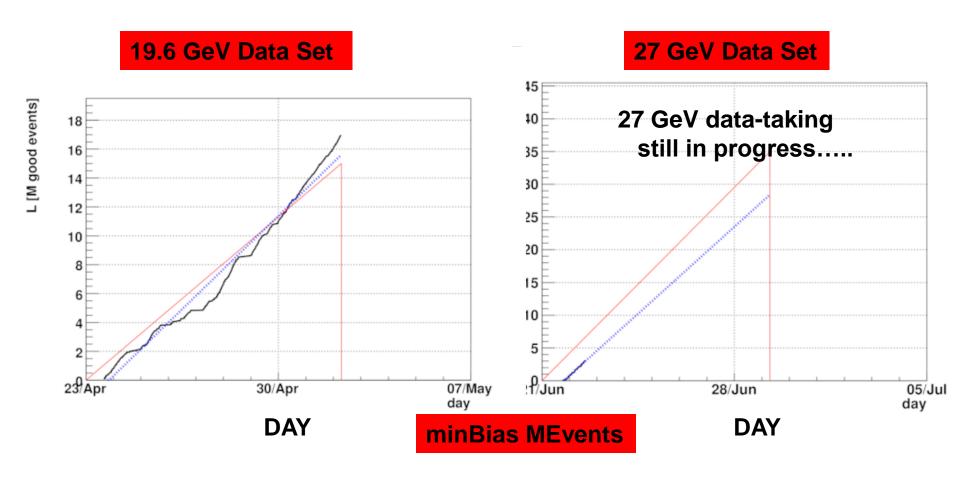


Central Au+Au collisions, like this one, can be analyzed even if there is a pile-up Au+Pipe Collision. But it is more challenging for peripheral collisions.

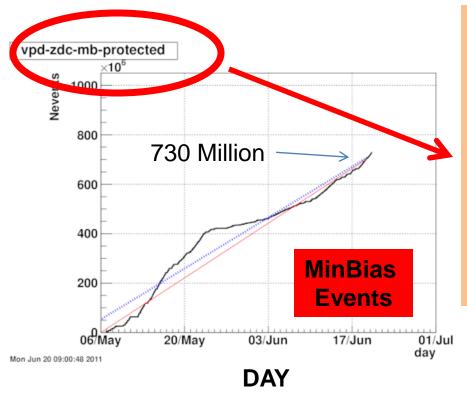
BES Sampled Luminosity 19.6 GeV and 27 GeV

17 Million minBias Events

hope for 35 Million minBias Events



Sampled Luminosity vs Projections: 200 GeV AuAu

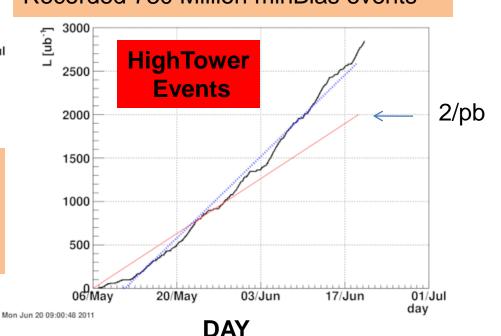


But take all rare triggers... Requested 2/nb

Actually recorded 2.846 /nb

Time Projection Chamber (with Future and Past Protection!)

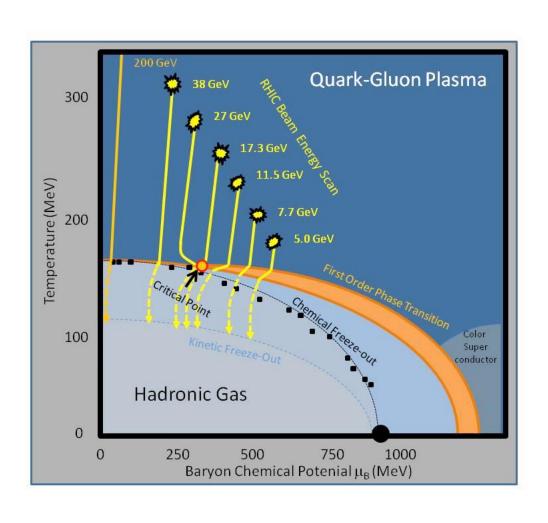
"Pristine" minBias events obtained by selecting events with NO secondary TOF or ZDC triggers within +/-45 microseconds. So many minBias events we can afford to throw away those contaminated by pileup tracks Recorded 730 Million minBias events



Heavy Ions

- Beam Energy Scan Au+Au: Probe nuclear EoS
 - 19.6 GeV
 - 27 GeV
 - Particle Spectra/Ratios
 - Anisotropic Flow/Azimuthal HBT
 - EbyE Fluctuations/Net proton kurtosis, skewness
- 200 GeV Au+Au
 - MinBias: low/intermediate mass di-leptons
 - Intermediate mass: $J/\Psi v_2$
 - Upsilon R_{AA} (suppression) (x3 in pp/x2in AuAu)
 - $-\gamma$ -jet correlations: energy loss of quarks in hard collisions
 - Jet modifications in general

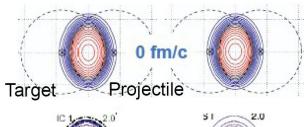
Beam Energy Scan



- Possible Critical Point predicted by Lattice Theory
- •STAR BES data on chemical freeze-out approaches the crossover region
- •STAR will look for experimental signatures in hadronic observables such as
 - Particle yields/ratios
 - Anisotropic Flow
 - Azimuthal HBT
 - Event-by-event fluctuations

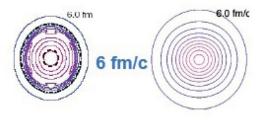
Azimuthal HBT

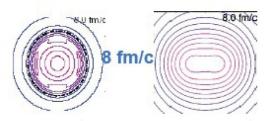
Spatial eccentricity









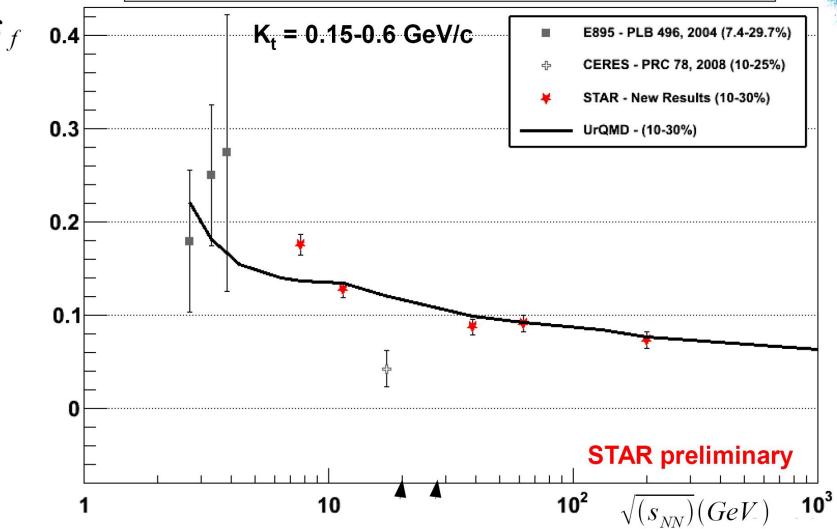


- Initial out-of-plane eccentricity
- Stronger in-plane pressure gradients drive preferential in-plane expansion
- Longer lifetimes or stronger pressure gradients cause more expansion and more spherical freeze-out shape
- We want to measure the eccentricity at freeze out, $\varepsilon_{\rm F}$, as a function of energy using azimuthal HBT: $\varepsilon_{\rm F} = \frac{R_y^2 R_x^2}{R_y^2 + R_y^2}$

• Non-monotonic behavior could indicate a soft point in the equation of state.

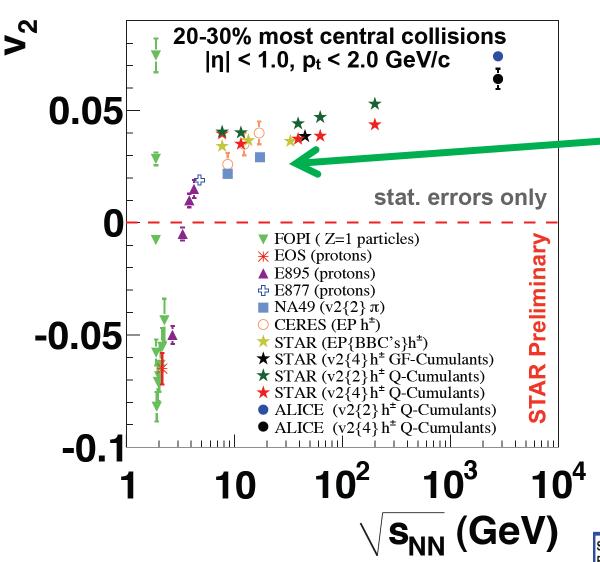
Excitation function for freeze out eccentricity, \in_{f}





UrQMD generally predicts the trend seen in the STAR data.

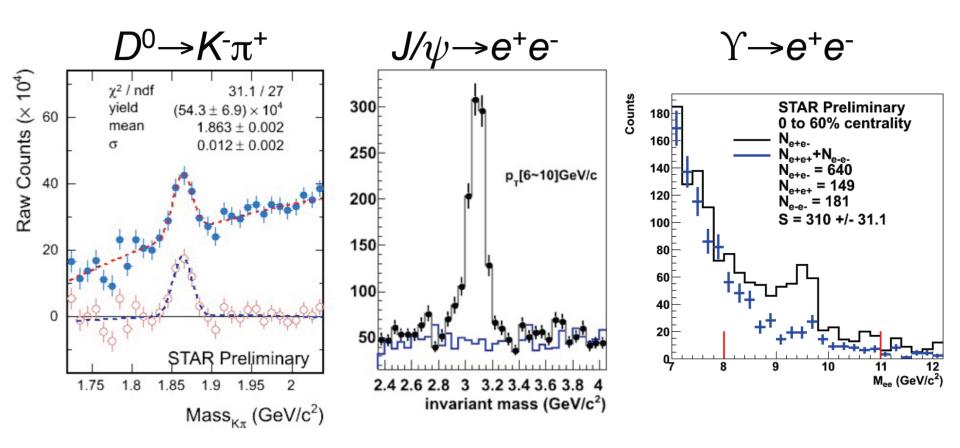
Plateau for Charged Hadron v₂



Plateau in v₂
might indicate
change of nuclear
equation of state
due to phase
transition.

S. A. Voloshin, A. M. Poskanzer, and R. Snellings, Landolt-Boernstein, Relativistic Heavy Ion Physics Vol. 1/23 (Springer-Verlag, Berlin, 2010), pp 5-54 FOPI Ref.: A. Andronic et al., PLB612 (2005) 173

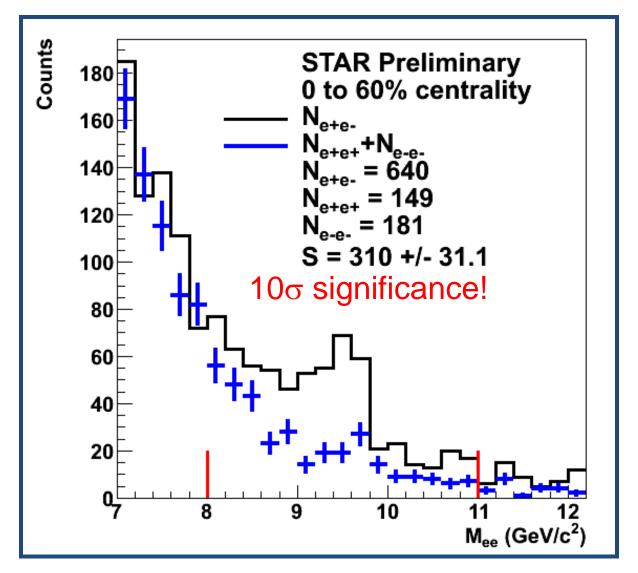
200 GeV AuAu: STAR Capability for Heavy Flavors



• Clear signal for D^0 mesons, J/ψ and Υ in Au + Au collisions

Y Yield 0-60% Centrality Au+Au Run 10

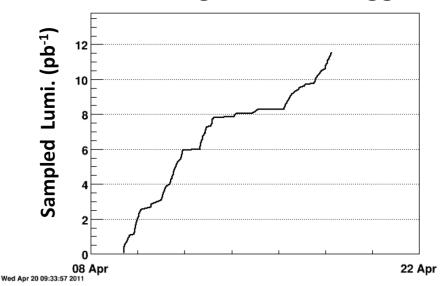
Run 10 Data # of minimum Bias events= 4.62x10⁹ # Triggers= 50M



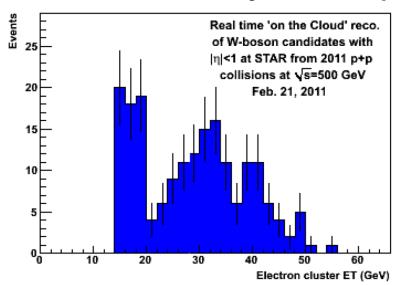
Run 11 Dataset

- Transverse Dataset (8 weeks of data taking):
 - W Trigger Sampled: $L \sim 25 \text{ pb}^{-1}$, $P \sim 40-50\%$ (online)
 - Possible feasibility studies for W A_N ?
- Longitudinal Dataset (9 days of data taking):
 - W Trigger Integrated: L ~ 12 pb⁻¹, <P> ~ 43% (online)
 - Similar to Run 9 dataset with slight increase in polarization

Run 11 Longitudinal W Trigger

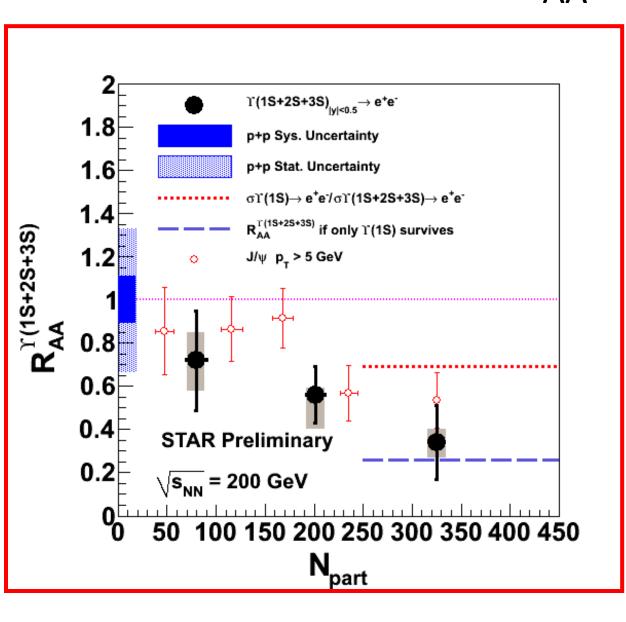


Run 11 "Online" Analysis: L~3.5 pb⁻¹



15

Υ (1S+2S+3S) R_{AA} Run 10



- Υ (1S+2S+3S) suppression in central collisions
- Similar suppression in high $p_T J/\Psi$
- First
 measurement of
 Y suppression

Yin Run 11

- Should x2 our Au+Au statistics, x3 pp statistics
- Since trigger and detector geometry are the same we can add run 10 and 11 directly
 - Significance in 0-60% centrality will be 14σ
 - $-R_{AA} \Upsilon(1S+2S+3S)$ in 0-10% will be 4σ from $R_{AA} = 1$
 - Will allow for $R_{AA} \Upsilon(1S+2S+3S)$ vs p_T in 0-60% centrality

STAR Run 11 Summary

- pp Running: Integrated luminosity was disappointing due to accelerator down periods
 - Spin: Transverse.... Successful!
 - Comparison of π , η asymmetries
 - Investigation of pT dependence
 - New triggers/calibrations allow investigation of photons, jets
 - Spin: Longitudinal...incremental results for Ws, Jets
- AuAu Running has gone well!
 - Beam Energy Scan: Fills in gaps for Nuclear EoS
 - 200 GeV AuAu: Increase in statistics ~x2 for key heavy flavor measurements

Thank You CAD!